Who Polluted the Missouri?*

Time

one 45-minute session

Vocabulary

aquatic, channelization, dam, flood, floodplain, habitat, meander, non-point source pollution, pollutant, pollution, sediment, terrestrial, turbidity, water quality, watershed

Objectives

Students will:

- become aware of the many different ways pollutants can enter water.
- discuss positive actions they can take to help prevent pollution.
- realize that protecting the environment requires ongoing changes in some of their daily habits.

Method

Students participate in a story conveyed about the Missouri River, while answering questions regarding water quality of the river.

Materials

2 clear, gallon jars of water (one jar is needed for 15 students)
1 labeled film canister per student (see *List of Characters*)

Background

The Missouri River is the longest river in the United States. It flows through the Rocky Mountains, Great Plains, Central Lowlands, and the Interior Highlands. The climatic zones differ from alpine, dry plains to humid forests with rainfall ranges from eight to 40 inches a year. Human alterations also have affected different portions of the river. The Missouri often is thought to be composed of three different rivers: the Upper, Middle, and Lower.

The Upper River, in western Montana, is very similar to what Lewis and Clark saw in 1804. Very little of it has been altered by humans. It **meanders** (turns or winds) and contains **habitat** (arrangement of food, water, shelter or cover, and space suitable to animals' needs) for **aquatic** (growing, living in, or frequenting water) and **terrestrial** (living or growing on land) animals and plants.

Six large **dams** (impoundments) have been built on the Middle River (in eastern Montana and North and South Dakota). The Corps of Engineers built the dams between 1937 and 1967, primarily for navigation and **flood** (abnormally high stream/river flow that overtops the banks of a stream/river) control, but also for hydropower, irrigation, and recreation. These dams control the release of water, so have reduced the river's flow variability. They also have reduced **turbidity** (the amount of light that can get through the water column due to the amount of suspended sediments in water that make the water muddy or cloudy) since the water drops **sediment** (fine soil and other particles that settle to the bottom of a liquid) when it is slowed by the dams. The Lower River's channel (bordering Iowa and Nebraska and through Missouri) has been narrowed and constrained to allow navigation. **Channelization** (straightening a river or stream) began in 1912 and has since resulted in increased depth and turbidity (although a recent study by the Environmental Protection Agency and the U.S. Geological Survey

* Adapted from "Who Polluted the Potomac," WETA, 2000.

Bureau shows that since the explorers' era, turbidity has still decreased due to the presence of upstream dams). Secondary channels, sloughs, and backwaters that provide critical habitat for aquatic life also were lost. Since channelization began, the **floodplain** (land near a stream/river which flood water spills onto) of the Lower River has been converted to agriculture and urban areas, increasing the amount of **pollutants** (substances that may contaminate the air, water, or soil) entering the river. Sections of the Lower River are on the federal list of impaired waterways due to arsenic and fecal coliform bacteria.

For more information on Lewis and Clark, refer to *Iowa's Water*, page 2.

Procedure

1. Prepare and label film canisters as described in the ***List of Characters*** for each student.
2. Fill two clear, gallon jars with water nearly to the top.
3. Divide the class into two groups and seat each group around one of the gallon jars of clean water. (Note: The activity is designed for up to15 students per jar.)
4. Distribute one set of canisters to each group of students. Ask them to keep them closed and to not reveal identities of their character or contents.
5. Explain that you will tell a story about the Missouri River and that each of them will play a part in the story. When they hear the name of their character mentioned in the story their job is to open the canister and empty its contents into the "river" (represented by the jar of clean water in the middle of their group).
6. Read the story, pausing after questions, and allowing students time to think and respond.
7. Research **pollution** (contamination of soil, water, or atmosphere by the discharge of harmful substances) problems in Iowa rivers, including the Missouri – which drains the western part of Iowa. What contributes the most pollution? (Agriculture – why? Agriculture has the greatest percent of land use). Discuss that the Mississippi drains the remainder of the state. Find the Divide on a map. Discuss **non-point source pollution** (pollution that enters water through runoff from land).

Evaluation

1. How has the Missouri River changed since Lewis, Clark, and the Corps of Discovery traveled its shores?
2. What is pollution?
3. How does pollution affect **water quality** (condition of water)? The Missouri River? People?
4. What can be done to prevent pollution?
5. What is the number one pollutant in Iowa's waters? (Refer to ***Iowa's Water*, page 6**.)

Extensions

Travel to a local stream/river and look for sources of pollution.

Visit the Iowa Geographic Image Map Server (ortho.gis.iastate.edu/) to view land use maps. Discuss possible pollutants generated by different types of land use in the Missouri River watershed or the **watershed** (land that drains into a particular body of water) of a river or stream near your school.

Change the story to symbolize a stream or river near your school.

Adopt a local stream/river.

Explore the world of point source and non-point source pollution with the EnviroScape™. To see a brochure for the EnviroScape,™ visit www.iowadnr.gov/education/files/envscp.pdf. For a list of locations that have an EnviroScape™, visit www.iowadnr.gov/education/envloc.html.

Teacher Aids

Posters:

"Aquatic Life." Ill. Brian Wignall. 1989. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Benthic Macroinvertebrates." Ill. SB Lauterbach. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Life in a Stream." Ill. Brian Wignall. 1989. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

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"Biodiversity of Iowa: Aquatic Habitats." 2001. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Living Landscape." Conservation Technology Information Center.

Books

Clark, W. and M. Lewis. 2002. The Definitive Journals of Lewis and Clark Up the Missouri to Fort Mandan. Edited by G. Moulton. Lincoln: University of Nebraska Press.

Zim, H.C. and A.C. Martin. 1987. A Golden Guide to Pond Life. New York: Golden Press.

List of Characters

Character	Substance in Canister
Construction site	1/2 tsp dry clay soil (not sand)
Trees	Dry leaves crumbled
Motorboat	1/8 tsp vegetable oil
Family picnic	Assorted litter (pull-tabs, Styrofoam, etc.)
People fishing	Tangle of nylon fishing line
Farmer	1/4 tsp baking powder
Farmer	1/2 tsp dry clay soil (not sand)
Barnyard	1/2 tsp brown liquid
Homeowner	Yellow food color + water + toilet paper (a full canister is most effective)
Coal mine	1/4 canister vinegar
Commuters	1/8 tsp vegetable oil
Gardeners	1/4 tsp baking soda
Antifreeze	1 tsp of blue/green food color + water
Washing the car	1/2 canister of soapy water
Mysterious liquid	1/8 tsp diluted red food color + water

There are 15 characters in the story, so you will need to prepare two sets of canisters for a group of 30. The above is a description of substances necessary for the canisters. All substances are safe for students to handle.

Note: It is best to use small amounts of each substance for a realistic effect.

Story: Who Polluted the Missouri?

For many thousands of years people have lived on the banks of the Missouri River. They hunted in forests and prairies, harvested food from wetlands and floodplains, and fished the river.

Question:

Imagine the jar of water in front of you was taken from the Missouri River by a Native American child about 200 years ago. Describe how it looks to you. Would you drink this water? Eat fish that came from it? Swim in it?

In 1804-1806 Lewis, Clark, and their crew of 40 men explored the Missouri to find the Northwest Passage to the Pacific Ocean, create a good relationship with the Native Americans to increase trade, observe and record natural history of the area, and look for resources for future settlers. All members kept a journal of their experiences and discoveries. In them, they wrote of Native American villages, prairie, and the river itself. They described the abundance of wildlife including large catfish that weighed an average of 33 pounds.

Soon pioneers began to arrive. They found the world's most fertile land for farming, forests and prairies teeming with game, and a river that provided ample food and water. The river was an outstanding environment for settlement and the pioneers prospered.

Question:

How do you think pioneers used the river? Do we use the river in the same ways today?

The Missouri River has changed a lot in the past 200 years. This is the story of the changes. Listen for the name of the character printed on your canister. When you hear your character named, open the canister and dump its contents into the river.

Imagine now that everything in the story is happening in the present – maybe even while we're sitting here today.

A sudden downpour drenches the area. The pounding rain is washing loose soil from a nearby ***construction site*** into the river. High winds whip through ***trees*** and blow leaves into the water too.

Question:

Is this water safe to drink? (If the response is "no," ask if the river had leaves or soil in it when Lewis and Clark drank from it?) Would you swim in it? Boat on it? Is it safe for wildlife?

In a short while, the storm passes over and the sun comes out again. People head for the river to have fun. Some zoom up and down the river in ***motorboats*** and don't notice that a little engine oil leaks into the water. Lots of ***families*** are ***picnicking*** in the parks too. Some people have left trash on the shore. During the next storm that trash will wash into the river. A ***person fishing*** on the dock snags the hook on a log and breaks the nylon fishing line.

Question:

Would you drink this water now? Would you swim in it? Go boating? Is it safe for wildlife? What litter is most dangerous for wildlife? Why?

Not everyone is out playing today. A ***farmer*** has been fertilizing cornfields in the Loess Hills. The rain washed some of the fertilizer off the land and into the nearby river. Another ***farmer*** tilled the field before it rained. Soil (sediment) washed into the river. This farmer also keeps pigs and other animals in the ***barnyard***. As rainwater drains out of the barnyard it carries some manure into a little creek behind the farm. The creek flows to the Missouri.

Out in the country, high on a hill, overlooking the river is a big old house. The ***homeowner*** has not maintained the septic tank. It is full and it is outdated. Untreated wastewater flows from the tank to a nearby ditch. It then flows to a small creek and into the Missouri.

Question:

Would you drink this river water now? Would you swim in it? Go boating? Is it safe for wildlife?

Along the Middle River (upstream in Montana) is a ***coal mine***. Rain water drained down into the shaft and soaked piles of wastes and scraps from mining. This made the water acidic – sort of like strong vinegar. The acidic water trickled into the Missouri. By the time it reaches Iowa's basic soils, it poses no problems for fish.

Many ***commuters*** drive their cars to and from work. If a car is not kept in good repair it might leak oil or other fluids that are washed off the pavement and into the river with the next rain.

Question:

Would you drink this water now? Swim in it? Go boating? Could fish or other wildlife live in water that was like vinegar?

Let's look in on some typical activities around the neighborhood. Lots of ***gardeners*** are out working in their yards today. Many of them are using weed killers and insect sprays to keep lawns pretty. The next rainfall will wash these into a little creek nearby and then into the Missouri.

There's a father teaching his daughter how to change ***antifreeze*** in their truck. They pour used antifreeze on the driveway. Antifreeze is sweet tasting and can poison an animal that licks it. It also can get into the nearby creek and poison fish. Later, father and daughter ***wash the car***. The soapy water rushed down the driveway into the storm drain; the storm drain empties into the local creek, which empties into a tributary of the Missouri. Phosphates in detergents used to be a pollution problem because they acted like fertilizer, making too much algae grow in the river. Laws were passed to stop the use of phosphate soaps in order to help solve the algae problems. But grease and grime on a car contain asphalt from roads, asbestos from brakes, rubber particles from tires, heavy metals, and rust. If the father and daughter had gone to the local car wash, the water would have been treated before it was returned to the river.

Next door a family is cleaning out their garage. They find an old rusty can with a tattered skull and crossbones label still stuck on it. What could it be? It looks dangerous and they want to get rid of it before someone gets hurt. But how? Junior gets the idea: "Let's pour it down the drain out by the curb. Hurry up!" So the ***mysterious liquid*** goes down the storm drain. The poison is out of sight – but it is headed for the Missouri?

Question:

Who polluted the Missouri?